DOCUMENT RESUME

ED 062 179 SE 013 642

TITLE	Authorized Course of Instruction for the Quinmester Program. Science: Genetics; Continuity of Life; and Perpetuating the Species.
INSTITUTION	Dade County Public Schools, Miami, Fla.
PUB DATE	71
NOTE	59p.
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	Biology; Course Content; *Genetics; Instruction; *Objectives; Reproduction (Biology); Secondary School Science; Sex Education; *Teaching Guides; Units of Study (Subject Fields)
IDENTIFIERS	*Quinmester Program

ABSTRACT

Each of the three secondary school science units, prepared for the Dade County Florida Quinmester Program, concerns some aspects of genetics. "Genetics" requires previous study of biology and concentrates on in-depth study of the nature, transmission, and function of the genetic material. There are no formal prerequisites for the units "Perpetuating the Species" and "Continuity of Life," both concerned with basic principles of animal and plant reproduction and genetics. Each unit contains a list of performance objectives, a synoptic course outline, recommended instructional activities and student laboratory exercises (details are not included, but reference to the appropriate source is made), a list of state-adopted texts, ideas for projects and reports, and a list of visual aids available from the county and other sources. There are extensive reference lists. A chart relating each suggested activity to specific objectives is appended to each booklet. (AL)

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AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

GENETICS

5315.40

SCIENCE
(Experimental)

DADE COUNTY PUBLIC SCHOOLS
DIVISION OF INSTRUCTION • 1971

GENETICS

5315.40
SCIENCE
(Experimental)

Written by William C. Gunn and Leonard L. Roesler, Jr.
for the
DIVISION OF INSTRUCTION
Dade County Public Schools
Miami, Fla.
1971

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Price: $.75

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GENETICS

COURSE DESCRIPTION:

This course focuses on three main ideas: the nature, transmission and function of genetic material. New information and the revolutionary discoveries of recent years are introduced. The physical and chemical nature of genetic material, various types of mutations and the structure and amino acid content of proteins are discussed. Experimental evidence that nucleic acids dictate protein structure is explored. Aspects of DNA are examined, with distinctions between what is known and what is hypothesized. The laws of gene transmission are included.

ENROLLMENT GUIDELINES:

The student must have completed four quinmester courses of biology, or the equivalent.

STATE ADOPTED TEXTBOOKS:

1. Biological Science Curriculum Study Committee. Biological Science: Molecules to Man, 2nd. ed. Boston: Houghton Mifflin Company, 1968.
2. Biological Science Curriculum Study Committee. Biological Science: An Inquiry Into Life, 2nd. ed. New York: Harcourt, Brace and World, 1968.
3. Biological Science Curriculum Study Committee. High School Biology: BSCS Green Version, 2nd. ed. Boston: D. C. Heath and Company, 1965.
4. Glass, Bentley, BSCS Laboratory Block, Genetic Continuity. Boston: D. C. Heath and Company, 1965.
5. Sussman, Alfred S. A Laboratory Block, Microbes, Their Growth, Nutrition and Interaction. Boston: D. C. Heath and Company, 1964.
6. Grobman, Arnold et al. BSCS Interaction of Experiments and Ideas. Englewood Cliffs, New Jersey: Prentice Hall Company, 1965.

RECOMMENDED TEXTBOOK:

7. Bonner, David M., and Mills, Stanley E. Heredity. Englewood Cliffs, New Jersey: Prentice Hall Company, 1965.

PERFORMANCE OBJECTIVES:

The student will:

1. State the basic assumptions of Mendel's gene theory.
2. Document the discoveries that focused on chromosomes as carriers of gentic information.
3. Recognize the difference between empirical and theoretical data.
4. Use genetic facts as well as scientific methodology to solve genetic problems..
5. Transcribe verbally described case histories into genetic symbols.
6. Recall terms used in genetics.
7. Formulate hypotheses by analyzing genetic data.
8. Make predictions by analyzing genetic data.
9. Recognize the need for revision of the gene theory on the basis of the differences between predictions and experimental results.
10. Design an experiment to demonstrate a genetic phenomenon.
11. Compare predictions with observations (actual genetic data).
12. Compare the events of mitosis with the events of meiosis.
13. Document evidences which led to the Watson Crick model of DNA.
14. Depict the events in protein synthesis.
15. Cite causes, and the consequences of mutations.
16. Summarize genetic information from current scientific literature.

COURSE OUTLINE

I. Cytology of Heredity

A. Cellular Inclusions
1. Cell inclusions which do not function directly in heredity.
2. Cell inclusions which function in heredity.

B. Sequences in Development
1. Fertilization
2. Mitosis (Growth)
(a) The process of cell and nuclear division is called mitosis.
(b) Mitosis is a continuous process divided into phases.
(1) Interphase
(2) Prophase
(3) Metaphase
(4) Anaphase
(5) Telophase
3. Meiosis
(a) Meiosis precedes the fusion of sex cells.
(b) Each sex cell has its own complement of chromosomes.
(c) In meiosis the chromosome number is reduced from diploid to monoploid.
(d) Monoploid or diploid numbers are constant for any species.
4. Differentiation

C. Role of the Nucleus
1. Mendelian evidence
2. Genes only control hereditary traits.

D. Role of the Environment
1. Environment appears to have no effect on genetic change
2. E Coli-Streptomycin studies

E. Role of the Cytoplasm
1. Most of the cytoplasm in a zygote is derived from the female
2. Particulate elements in cytoplasm (chloroplasts) control variegation in some plants
3. Studies of "killer" vs. "sensitive" Paramecium indicate cytoplasmic particle "kappa" in killer strain

II. Genetic Material: Composition and Discoveries

A. Chemical nature of proteins

B. The DNA molecule
1. DNA isolated from many different organisms has many of the same properties.
(a) It is made up of nucleotides
(1) Phosphoric acid
(2) Deoxyribose, a 5 carbon sugar
(3) One of the four types of bases

(b) The structure of the purine nucleotides
(1) Deoxyadenylic acid
(2) Deoxyguanilic acid
(c) The structure of the pyrimidine nucleotides
(1) Deoxythmidilic acid
(2) Deoxycytidilic acid

2. Discoveries that led to the formation of a molecular model of DNA.
(a) The discoveries of Irwin Chargaff and his colleagues
(1) The relative amount of any given nucleotide varies widely among different organisms
(2) Within any given sample of DNA the amount of the purines always equalled the amount of the pyrimidines
(3) Deoxyadenilic molecules always equalled Deoxythymidilic molecules
(b) M. H. F. Wilkins perfected techniques of determining molecular structure by using X-ray diffractions
(c) The James Watson and Francis Crick model of DNA

C. Replication
1. The double stranded structure of DNA provides a hypothesis for its replication mechanism
2. In replication, each strand maintains its structural integrity.
(a) Base pairing forces the synthesis of an exact image of itself in the complementary strand.
(b) Studies by Meselson and Stahl.
3. Some kind of primer is necessary in the replication process.
4. Arthur Kornberg's synthesis of DNA in Vitro using the enzyme DNA polymerase.
5. It is possible to separate the two strands of DNA by critical heat and maintain the separation by cooling.
(a) Each strand serves as a primer for double stranded DNA.
(b) Rose Lipman - Walter Szybalski experiment, using Kornberg's enzyme.
6. The replication begins at one end and progresses along the strand.
7. Cairn's work using electron microscopy and autoradiology.

D. Coding
1. Overwhelming evidence indicates that the code is made up of three DNA letters (the triplett code).
2. Each combination of letters carries one amino acid.

E. Mutation
1. Alternation of the nucleotide
2. Change in the geometry of a chromosome.
(a) Deletion
(b) Point mutation
(c) Inversion
(d) Translocation

III. Studies of How Chromosomes Control Heredity

A. Transformation
   1. Oswald Avery's contribution to chemical identification of heredity materials
   2. Transformable traits in bacteria
   3. Szybalski experiment - transformation in metozoan (human) cells

B. The role of bacterial viruses in identification and formation of genetic material
   1. Infective phase.
   2. Vegetative phase.
   3. Progeny formation phase.
   4. Only viral DNA enters the bacterial cell and initiates formation of new viruses.

C. Experiments with infective RNA
   1. TMV virus
   2. Polio virus

IV. Genes

A. A gene is a unit of DNA
   1. Genes may occur in alternate forms called alleles.
   2. Genes are arranged along chromosomes in a line.
   3. Each gene along a line posseses a distinct function from that of other genes.

B. Knowledge of Gene Structure Makes Possible Mapping of Chromosomes.
   1. Results of breakage-fusion
   2. Results of copy-choice

C. Structure of the Gene
   1. Mutons
   2. Irregularity of mutations
   3. Cistrons

D. The Inheritance Test in Neurospora
   1. Spreading Gene X Colonial Gene
      (a) First reduction division
      (b) Second reduction division
   2. Random assortment of genes on different chromosomes
      (a) Assumed location of alleles on chromosomes
      (b) Segregation of alleles
      (c) Results
      (d) Consequences of sex

E. Linked Genes (Genes on the same chromosome)
   1. Morgan's Evidence
   2. Transmission
      (a) Normal expectancy
      (b) Consequences

3. Recombination through Crossing Over
   (a) First meiotic division
   (b) Second meiotic division
   (c) Consequences of crossing over
   (d) Significance of crossing over in mapping chromosomes

F. Genes influence other genes
   1. Beta-galactosidase permease syndrone
   2. Francis Jacob's work with "operator genes."

G. Gene Action in Terms of Cell Chemistry
   1. Genes control cellular reactions in the synthesis of essential compounds.
   2. Essential compounds are synthesized by a series of well defined steps.
   3. Beadle and Tatum Experiment
      (a) Hypothesis
      (b) Experiment
      (c) Data
      (d) Conclusions

H. Genes and Nutrition
   1. Biochemical similarities between cells of diverse organisms
      (a) Types of molecules common to all cells.
      (b) Cell's ability to synthesize vital components through well defined chemical reactions.
         (1) Basic nutritional requirements
            (a) Ability to synthesize required nutrients
            (b) Dependence on other sources
         (2) Energy requirements
            (a) Energy releasing reactions
            (b) Energy storing reactions
   2. Roles played by enzymes
      (a) Characteristics of enzymes
      (b) Chemical make-up
      (c) Specific roles
      (d) Factors affecting their activities

V. Mutation

A. The Loss of Ability to Carry out a Specific Reaction
   1. The loss of the reaction ability results from the loss in enzyme activity which catalyzes the reaction
      (a) Studies with Tryptophan Synthetase (T'ase)
      (b) Location of the genone which directs T'ase formation
      (c) The affect of mutation on the genone
      (d) Characteristics of T'ase
         (1) T'ase as an antigen
         (2) Production and utilization of T'ase antibodies
            (a) Reaction with T'ase antigens
            (b) Reaction with compounds similar to T'ase

2. Discovery of a T'ase-like protein, CRM (cross reacting material)
   (a) Two varieties
      (1) CRM^+, capable of forming a protein which is unable to convert InCP + Serine ——Tryptophan
      (2) CRM^-, which is unable to form a protein
   (b) Both CRM^+ and CRM^- react with T'ase antibodies

B. An Alteration in the Protein Structure of an Enzyme
   1. The structure of proteins
      (a) Molecular weights
      (b) Bonding
      (c) Catalytic sites
      (d) Folded structure
   2. Enzyme alteration
      (a) Gene controls amino acid sequence
      (b) Gene site determines amino acid location
   3. Analysis of mutant protein should yield amino acid substitution
      (a) Fingerprinting reveals differences in the amino acid sequence in a normal and mutant protein
      (b) Difference in equine and bovine RNAse

VI. Summary of Genetic Concepts

A. Mutation and Selection - environmental conditions favor some mutants.

B. Bacterial Recombination - transformation can result in a heterezygous condition in some haploid organisms.

C. Diploidy recombination plays a major role in genetic variation

D. Dominance - the ability to synthesize an active enzyme qualifies a gene as dominant.

E. Mendelian 3:1 Ratio

F. Mendelian 9:3:3:1 Ratio

G. Linkage
   1. Some genes are linked together on the same chromosome.
   2. Recombination through crossing over.

VII. Human Genetics

A. The Chromosomal Basis of Gene Transmission.

B. Some Congenital Diseases in Man
   1. Mongolism - from non-disjunction
   2. Phenylketonuria - single gene difference
   3. Sickle Cell Anemia - single gene difference

C. Multiple Alleles in Man
   1. Blood groups
   2. Skin color

D. Sex Determination
   1. Structural vs. functional differences in chromosomes.
   2. Effects of non-disjunction

EXPERIMENTS

BSCS, Student Laboratory Guide, An Inquiry into Life. 2nd. ed. Atlanta: Harcourt, Brace and World, Inc., 1968.

1. Amino Acid Composition of an Unknown (Inquiry 6-2, p. 43)
2. Mitosis and Genetic Continuity (Inquiry 7-1, p. 52)
3. An Analysis of DNA (Inquiry 8-1, p. 58)
4. Trailing a Virus (Inquiry 8-3, p. 58)
5. Investigating Differences in Peas (Inquiry 8-3, p. 59)
6. A Disease of Bacteria (Inquiry 9-2, p. 69)
7. Inheritance of one Factor Differences (Inquiry 29-2, p. 188)
8. Sex Linked Inheritance (Inquiry 30-1, p. 197)
9. A Trait in Human Inheritance (Inquiry 32-2, p. 204)
10. Sickle Cells and Selection (Inquiry 32-4, p. 211)

BSCS, Biological Science: Molecules to Man. 2nd. ed. Boston: Houghton Mifflin Company, 1968.

11. Investigating Cell Division (Investigation 11-5, p. 270)
12. Nucleic Acids in Action (Investigation 9-3, p. 219)
13. Investigating Mutants in Neurospora (Investigation 10-12, p. 249)
14. Investigating Genetic Differences in Pea Seeds (Investigation 16-2, p. 406)
15. Investigating the Influence of Heredity and Environment (Investigation 15-3, p. 377)
16. Investigating Blood Type Genetics (Investigation 15-19, p. 399)

BSCS, Interaction of Experiments and Ideas. Englewood Cliffs, New Jersey: Prentice Hall Company, 1965.

17. Determining Mutation Frequency in Bacteria (Investigation 9, p. 133)
18. The Interaction of Two Mutants of a Bacterium (Investigation 10, p. 137)
19. A Verification of Results (Investigation 11, p. 140)
20. A Study of the Interactions Between Unknown Mutants (Investigation 12, p. 141)
21. Confirmation of Strains and Genotypes (Investigation 14, p. 148)
22. Heterokaryosis and Complementation (Investigation 15, p. 152)

BSCS, A Laboratory Block, Genetic Continuity. Boston: D. C. Heath and Company, 1965.

23. Linkage and Crossing Over (Investigation 15, p. 70)
24. Do Ordinary Changes Imposed on a Phenotype Become Inherited (Investigation 19, p. 94)
25. How Genes Produce Effects (Investigation 20, p. 100)

26. The Determination of the Mutation Rate of a Specific Gene and Artificial Induction of Mutation (Investigation 24, p. 133)
27. Independent Inheritance (Investigation 14, p. 68)
28. Finding Mutations and Determining How They Are Inherited (Investigation 23, p. 131)
29. The Induction of Polyploidy in Cells (Investigation 5, p. 24)
30. Plant Albinism (Investigation 18, p. 92)
31. Sex Linked Inheritance (Investigation 16, p. 76)
32. Classification and Heredity of Human Traits (Investigation 17, p. 87)
33. Blood Typing and Blood Group Frequencies (Investigation 22, p. 126)
34. Preparation and Examination of Cells in Mitosis (Investigation 4, p. 22)
35. Models to Illustrate Meiosis and Fertilization (Investigation 10, p. 42)

BSCS, Laboratory Block, Microbes, Their Growth, Nutrition and Interaction. Boston: D. C. Heath and Company, 1965.

36. Preliminary Analysis of a Nutrient Requirement (Investigation 12, p. 76)
37. Specific Requirements and Assay (Investigation 13, p. 77)
38. Bioassay of Nutrients (Investigation 14, p. 78)

PROJECTS

1. Collect wild Drosophila and examine to see if there are any variations that may be hereditary. Breed to establish the type of gene transmission.

2. Obtain from local research laboratory both Streptomycin sensitive and Streptomycin resistant E. Coli. Try to induce transformation.

3. There are several experiments in the book: Twenty-six Afternoons of Biology which can be expanded into projects.

4. Subject microorganisms such as bacteria and molds to ultra violet radiation to induce mutations.

5. Design an experiment to demonstrate transduction. T_4 phages are available from supply houses.

6. Irridiate pollen grains from a certain species of plant. Use these to artificially pollinate flowers of the species. Examine offspring for variation.

7. There are many seeds available from Oak Ridge Laboratories that can be used for genetics projects.

8. Pineapples and Spanish Moss are related. Pineapples contain an enzyme which will digest proteins. Design an experiment to test for the same kind of enzyme activity in extracts from Spanish Moss.

REPORTS

Students can abstract from Scientific American articles listed in the references. These can be presented as written reports or as seminar type presentations.

FIELD TRIPS

Local scientists engaged in genetic research are not receptive to large groups visiting their laboratories for reasons of space, schedules, and the fact that some of them direct research in several laboratories that are in different geographical locations. However, they are amenable to a few interested students visiting their facilities.

SPEAKERS

Consult the Visiting Scientist Program, Florida Academy of Sciences. See brochure.

SPECIAL PROBLEMS

1. This course is based on the book Heredity by David M. Bonner and Stanley Mills.

2. The course deals primarily with the physical and biochemical structures and activities of genetic material. It is also heavily oriented towards the genetic activities of microorganisms.

3. Previous knowledge of genetics will be a great asset in this course, but is not prerequiste. Teachers may want to survey their classes, early in the course perhaps with a pre-test, to determine the ability levels and knowledge their students have of the subject.

4. A variety of lab experiences are suggested at many levels of sophistication. It would be impossible to complete all the labs within a quinmester. The teacher should choose those which are best adapted to their student's ability levels, time schedules, and available facilities. Order materials in advance so they will be available when needed.

5. Some of the labs may be assigned as projects to better students.

6. This quin, as written, does not mandate the curriculum. Hopefully, it can be adapted to a variety of teaching strategies. It can be adapted to:

    a. A self pacing, individualized learning approach.
    b. A small group seminar-research type approach.
    c. A structured situation in which all students participate in the same activities.

7. References are included for BSCS Blue, Yellow and Green Versions. A few copies of each of these in the classroom or resource center may be useful as reference sources.

8. The Scientific American references contain in-depth descriptions of most of the research contained in the texts and outline. Students may be assigned to abstract from these articles for seminar type presentations or written reports.

9. Several modern genetics texts, as well as some "fun" reading materials should be available to the students. The Dictionary of Genetics, listed in the references, is a good resource.

10. Graduate college students encounter much frustration and failure working with Neurospora Crassa. The "nutritional sleuthing" experiments in Sussman's book are manageable, but require expensive materials.

11. Film loops can be used effectively to teach lab techniques.

DADE COUNTY 16mm FILMS

1. Bacteria, Laboratory Study
   AV# 1-11118, 15', C
2. Basic Nature of Sexual Reproduction
   AV# 1-11122, 15', C
3. Biochemical Genetics
   AV# 1-30572, 28', C
4. Blood Groups, Skin Color, and Gene Pools
   AV# 1-30587, 28', C
5. Cell Division
   AV# 1-02236, 11', BW
6. Cell Reproduction (Mitosis)
   AV# 1-30511, 28', C
7. Chromosomes and Sex
   AV# 1-30577, 28', C
8. DNA, Molecule of Heredity
   AV# 1-11078, 16', C
9. Fertilization
   AV# 1-30464, 28', C
10. Genes and Chromosomes
    AV# 1-30429, 28', C
11. Genetics, Improving Plants and Animals
    AV# 1-11050, 28', C
12. Heredity
    AV# 1-02224, 11', BW
13. Heredity and Environment
    AV# 1-02226, 10', C
14. Mitosis and Meiosis
    AV# 1-11083, 15', C
15. Mutation
    AV# 1-30597, 28', C
16. Radiation and Biology
    AV# 1-11101, 14', BW
17. The Thread of Life, Part I
    AV# 1-30568, 30', C
18. The Thread of Life, Part II
    AV# 1-30570, 30', C
19. Virus
    AV# 1-30533, 28', BW
20. Heredity and Prenatal Development
    AV# 1-103029, 30', C

DADE COUNTY TRANSPARENCES

T1. DNA AV# 230083
T2. Genetic Resemblences and Differences due to Heredity AV# 2-00073
T3. Mitosis and Cell Division AV# 2-00008

8mm FILM LOOPS

L1. Chromosomes-Onion Root Tip Preparation
L2. Chromatography-Using a Pie Plate
L3. Bacteria-Reproduction
L4. Bacterial Mutants Part I: Inducing Mutations by Ultraviolet Irradiation
L5. Bacterial Mutants Part II: Detecting Nutritional Mutants by Replica Plating
L6. Handling Drosophila
L7. Experimenting with Drosophila
L8. Histological Techniques
L9. Squash Techniques
L10. Bacteriological Techniques I
L11. Bacteriological Techniques II
L12. Paper Chromatography I
L13. Paper Chromatography II
L14. Smear and Squash Techniques I
L15. Smear and Squash Techniques II
L16. Neurospora Techniques I
L17. Neurospora Techniques II
L18. Genetics of Sardaria
L19. DNA Transformation Experiment

SUGGESTED DISCUSSION QUESTIONS

1. Rabbit eggs have been stimulated to develop without fertilization, and certain of the parthenogenetic rabbits so formed have been reported to be heterozygous for certain allelic pairs. How might this be explained?

2. List particular advantages for using the following organisms for genetic research: corn, Drosophila, Neurospora, bacteriophage.

3. The frequency of crossing over is a function of the distance between the gene and the centromere of its chromosome. How do you explain this?

4. Why is it easier to localize genes carried in the sex chromosomes than it is to localize genes carried in particular autosomes?

5. Which would be expected to produce more specific effects on the characteristic of an organism, a gene mutation or a chromosomal abberation?

6. Man has a double inheritance. Our biological inheritance comes from parent to child through genes. Our cultural inheritance comes from the millions who have gone before us. Explain.

7. Mutations affect an organism much as typographical errors affect what we are reading. Explain.

8. How would you explain: "Chromosomes are double threads of life?"

9. Suppose that you discover in Drosophila a mutation that appears to result from a single dominant gene. Devise a procedure to determine on which chromosome the locus of the mutant gene is to be found.

10. Before Mendel, the chief theory of heredity was "blood line inheritance". According to this theory, the parents traits are blended in the offspring just as two liquids blend when mixed together. Give evidence in support of the older theory. Then show how the results of Mendel's experiments fail to fit that theory.

11. How are chromosome maps made?

12. Outline the history of "cracking the genetic code".

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Articles in Scientific American

1. "The Genes of Men and Molds" by George Beadle. September, 1948, Vol. 179, No. 3
2. "Viruses" by F. M. Burnet. May, 1951, Vol. 184, No. 3
3. "How Antibodies are Made" by F. M. Burnet. November, 1954, Vol. 191, No. 5
4. "The Structure of Hereditary Materials" by F. C. H. Crick. October, 1954, Vol. 191, No. 4
5. "Proteins" by Paul Doty. September, 1957, Vol. 197, No. 3
6. "Rebuilding a Virus" by Heinz Fraenkel-Conrat. June, 1956, Vol. 194, No. 6
7. "Proteins" by Joseph S. Fruton. June, 1950, Vol. 182, No. 6
8. "The Gene" by Norman Horowitz. October, 1956, Vol. 195, No. 4
9. "Transformed Bacteria" by Rollin D. Hotchkiss and Ester Weiss. November, 1956, Vol. 195, No. 5
10. "The T_2 Mystery" by Salvador Luria. April, 1955, Vol. 192, No. 4
11. "Cell Division" by Daniel Mazia. August, 1953, Vol. 189, No. 2
12. "The Chemistry of Heredity" by A. E. Mirsky. February, 1953, Vol. 188, No. 2
13. "Partner of the Gene" by T. M. Sonneborn. November 1950, Vol. 183, No. 5
14. "The Multiplication of Bacterial Viruses" by Gunther S. Stent. May, 1953, Vol. 188, No. 5
15. "Sexuality in Bacteria" by Elie L. Wellman and Francois Jacob. July, 1956, Vol. 195, No. 1
16. "The Duplication of Chromosomes" by J. Herbert Taylor. June, 1958, Vol. 198, No. 6
17. "Nucleic Acids and Proteins" by Mahlen B. Hoagland. December, 1958, Vol. 201, No. 6
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22. "The Fine Structure of the Gene" by Seymour Benzer. January, 1962, Vol. 206, No. 1
23. "The Bacterial Chromosome" by John Cairns. January, 1966, Vol. 214,No. 1
24. "The Nucleotide Sequence of a Nucleic Acid" by Robert W. Holley, February, 1966, Vo. 214, No. 2
25. "Chromosomes and Disease" by A. G. Bearn and James L. German III, November, 1964, Vol. 204, No. 5
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MASTER SHEET - GENETICS

Subject	Textbooks	Experiments	References	Films	Film Loops Transparencies
Material Basis of Heredity	1 Ch. 11, pp.261-272 2 Ch. 7, pp.127-145 3 Ch. 17, pp.586-591 7 Ch. 1, pp. 1-7	1, 2, 11, 34, 35	11, 16, 20	7, 14, 5, 6, 9	L1 T3 L8, L10, L11
DNA, Genetic Material	1 Ch. 9, pp.214-231 2 Ch. 8, pp.147-166 3 Ch. 17, pp.661-662 7 Ch. 2, pp. 8-16	3, 4, 6, 12	2, 4, 6, 9, 14, 18, 24	8, 1, 19	L3, T1, L19
Genes and Biochemical Reactions	1 Ch. 10, pp.234-248 2 Ch. 30, pp.545-554 3 Ch. 17, pp.660-662 7 Ch. 3, pp.17-33	23, 24, 36, 37, 38	1, 8	3, 7	L4, L5, L16, L17
Genes and Enzymes	1 Ch. 10, pp.249-257 2 Ch. 8, pp.167-168 3 Ch. 17, pp.664-666 7 Ch. 4, pp. 34-35	12, 17, 19, 20	3, 8, 13, 17, 19, 21	15	L2, L9, L14, L15
Genes in Action	1 Ch. 9, pp.214-231 2 Ch. 8, pp.170-171 3 Ch. 17, pp.642-643 7 Ch. 5, pp. 46-60	5, 14, 25, 26	4, 5, 7, 10, 23	16	
Molecular Structure of a Gene	1 Ch. 16, pp.420-425 2 Ch. 30, pp.558-565 3 Ch. 17, pp.642-643 7 Ch. 6, pp. 61-71	21, 22, 23, 28	12, 22, 23, 24	10	
Genes and Development	1 Ch. 15, pp.374-380 2 Ch. 28, pp.515-517 3 ---------- 7 Ch. 7 pp. 72-80	15, 27, 29	15, 13	13	L6, L7
Genetic Mechanisms	1 Ch. 15, pp.380-396 2 Ch. 29, pp.521-535 3 Ch. 17, pp.653-659 7 Ch. 8, pp. 81-92	7, 8, 30, 31	9	11	
Genes and Man	1 Ch. 16, pp.415-423 2 Ch. 29, pp.533-539 3 Ch. 17, pp.653-659 7 Ch. 9, pp. 93-105	16, 33, 9, 10	25	4	T2

ED 062179

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N.LS

AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

CONTINUITY OF LIFE

5314.11

SCIENCE
(Experimental)

DADE COUNTY PUBLIC SCHOOLS
DIVISION OF INSTRUCTION • 1971

CONTINUITY OF LIFE
5314.11
SCIENCE
(Experimental)

Written by Nancy D. McCarthy and Barbara A. Silver
for the
DIVISION OF INSTRUCTION
Dade County Public Schools
Miami, Fla.
1971

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CONTINUITY OF LIFE

COURSE DESCRIPTION:

This course is designed to present the student with one of the basic concepts in biological sciences -- how life is perpetuated. It includes consideration of reproductive processes in both plants and animals, and the science of heredity, genetics.

ENROLLMENT GUIDELINES:

This course is strongly recommended for college bound students and those who desire one credit in biology. There are no pre- or corequisites.

STATE ADOPTED TEXTS

1. Biological Sciences Curriculum Study Committee. Biological Science: An Inquiry Into Life, 2nd. ed. New York: Harcourt, Brace & World, 1968. (Yellow Version)

2. Biological Sciences Curriculum Study Committee. Biological Science: Molecules to Man, 2nd. ed. Boston: Houghton Mifflin Company, 1968. (Blue Version)

3. Biological Sciences Curriculum Study Committee. High School Biology: BSCS Green Version, 2nd. ed. Chicago: Rand McNally & Co., 1968.

4. *Otto, James H. and Towle, Albert. Modern Biology. New York: Holt, Rinehart and Winston, Inc., 1965.

5. Smallwood, William and Green, Edna R. Biology. Morristown, New Jersey: Silver Burdett, 1971.

* off adopted list, 1971.

PERFORMANCE OBJECTIVES

THE STUDENT WILL:

1. Differentiate between the two basic patterns of reproduction.

2. Recognize the various types of asexual reproduction.

3. Describe the process of mitosis.

4. Explain the significance of mitosis to the biological continuity of life.

5. Relate the process of meiosis to sexual reproduction.

6. Investigate the pattern of reproduction known as alternation of generations.

7. Discover the relationship between reproductive structure and function in the flowering plant.

8. Propose reasons to account for flowering plants being the most successful group of land plants.

9. Relate the structures of the male and female reproductive systems of animals to their reproductive function.

10. Contrast external and internal patterns of fertilization in animals in terms of biological advantages or disadvantages.

11. Describe the functions of the various extraembryonic membranes found in reptiles and birds, and in mammals.

12. Explain the role of the various hormones involved in the reproductive process in placental mammals.

13. State the function of each of the three interrelated processes of development.

14. Describe the developmental processes in seed plants.

15. Interpret the work of Wilhelm Roux and Hans Driesch in terms of the ideas of epigenesis and preformation.

16. Describe the events involved in the development of an animal from a zygote to a three-layered embryo.

17. Investigate normal and abnormal variations in development.

18. State reasons for the success of Gregor Mendel.

19. Define the following terms:

genetics	F_1 (first filial generation)	allele
pure breeding	F_2 (second filial generation)	genotype
self-pollination	dominant	phenotype
cross-pollination	recessive	homozygous
P_1 (parental cross)	incomplete dominance	heterozygous
		test cross

20. Apply the principles of probability to the solution of genetics problems.

21. Solve monohybrid and dihybrid crosses using a Punnet square or the algebraic method.

22. Recognize the parallels between Mendel's hereditary factors and the behavior of chromosomes and genes.

23. Describe the effect of the following genetic occurrences: linkage, crossing over, non-disjunction.

COURSE OUTLINE

I. Reproduction

A. Essential features of reproduction
1. Process essential for survival of species
2. Differences between the two general patterns of reproduction

B. Cell reproduction
1. Mitosis
2. Meiosis

C. Asexual reproduction in plants and animals

D. Sexual reproduction in plants
1. Alternation of generations
2. Reproduction in flowering plants

E. Sexual reproduction in animals
1. Reproductive structures
2. External and internal fertilization
3. Extraembryonic membranes
4. Hormonal control of reproduction

II. Development

A. Patterns of development

B. Development in plants

C. Development in animals
1. Explanations of development
2. Events in development
3. Variations in development

III. Genetics

A. The work of Gregor Mendel

B. Probability in genetics

C. Hereditary patterns and problem solving

D. Non-Mendelian genetics
1. Chromosome theory
2. Sex-linkage
3. Non-disjunction
4. Crossing over

EXPERIMENTS

Biological Sciences Curriculum Study Committee. Biological Science: An Inquiry Into Life - Student Laboratory Guide, 2nd. ed., New York: Harcourt, Brace & World, Inc., 1968. (Yellow Version)

1. Mitosis and Genetic Continuity (Ex. 7-1, p. 52)
2. Reproduction in Paramecium (Ex. 18-6, p. 134)
3. Alternation of Generations (Ex. 14-1, p. 90)
4. Flowers (Ex. 17-1, p. 110)
5. Reproduction and Development in the Frog (Ex. 27-1, p. 169)
6. Effects of Reproductive Hormones (Ex. 26-1, p. 167)
7. Importance of Seeds (Ex. 14-3, p. 94)
8. From Seed to Seedling (Ex. 17-3, p. 117)
9. How Does an Egg Form a Chicken? (Ex. 27-2, p. 173)
10. Growing A New Body (Ex. 28-1, p. 178)
11. Randomness, Chance, and Probability (Ex. 29-2, p. 184)
12. Inheritance of One-factor Differences (Ex. 29-3, p. 188)
13. Independent Inheritance (Ex. 29-4, p. 194)
14. Sex-linked Inheritance (Ex. 30-1, p. 197)
15. Heredity and Environment (Ex. 30-2, p. 198)
16. A Trait in Human Inheritance (Ex. 32-2, p. 204)
17. Selection and Allele Frequencies (Ex. 32-3, p. 207)
18. Sickle Cells and Selection (Ex. 32-4, p. 211)

Biological Sciences Curriculum Study Committee. Biological Science: Molecules to Man, 2nd. ed., Boston: Houghton Miffling Company, 1968. (Blue Version)

19. Investigating Cell Division (Ex. 11-5, p. 270)
20. Investigating Reproduction in Flowering Plants (Ex. 13-6, p. 306)
21. Investigating the Life Cycle of Insects (Ex. 13-10, p. 311)
22. Investigating Development of the Plant Embryo (Ex. 14-2, p. 342)
23. Investigating Development of the Chick Embryo (Ex. 14-6, p. 349)
24. Investigating Regeneration in Planarians (Ex. 14-16, p. 365)
25. Investigating the Influence of Heredity and Environment on Plant Pigmentation (Ex. 15-3, p. 377)
26. Investigating a Cross Between Two Strains of Drosophila (Ex. 15-8, p. 385)
27. Investigating Blood Type Genetics (Ex. 15-19, p. 399)
28. Investigating Genetic Differences in Pea Seeds (Ex. 16-2, p. 406)

Biological Sciences Curriculum Study Committee. High School Biology: BSCS Green Version, 2nd. ed., Chicago: Rand McNally & Company, 1968.

29. Mitosis and Cell Division in Plant Cells (Ex. 11.3, p. 397)
30. A Model of Meiosis (Ex. 16.2, p. 589)
31. Vegetative Reproduction (Ex. 16.1, p. 582)
32. Chick Embryology (Ex. 16.3, p. 608)
33. Probability (Ex. 17.1, p. 629)
34. Mendelian Monohybrid Cross in Drosophila (Ex. 17.2, p. 636)
35. Seedling Phenotypes (Ex. 17.3, p. 651)

36. Human Inheritance (Ex. 17.4, p. 656)
37. Genetic Differences in Peas (Ex. 17.5, p. 667)

Otto, James H.; Towle, Albert and Crider, Elizabeth H. Biology Investigations. New York: Holt, Rinehart and Winston, Inc., 1965.

38. Cell Growth and Reproduction (Ex. 8-1, p. 63)
39. Genetic Facts and Fallacies (Ex. 9-1, p. 69)
40. Study of Mendelian Laws (Ex. 9-2, p. 71)
41. Chromosomes and Genes (Ex. 10-1, p. 77)
42. Crossing Fruit Flies to Study Heredity (Ex. 10-2, p. 81)
43. Sex Chromosomes and Linkage (Ex. 10-3, p. 85)
44. Gene Action (Ex. 10-4, p. 89)

DEMONSTRATIONS

Biological Sciences Curriculum Study Committee. Biological Science: Inquiry Into Life - Student Laboratory Guide, 2nd. ed. New York: Harcourt, Brace & World, Inc., 1968. (Yellow Version)

1. Drosophila Technique (Ex. 29-1, p. 180)
2. Testing Color Blindness (p. 238)
3. A Population Genetics Study (Ex. 32-1, p. 200)

Biological Sciences Curriculum Study Committee. Biological Science: Molecules to Man, 2nd. ed. Boston: Houghton Mifflin Company, 1968. (Blue Version)

4. Investigating the Action of Hormones on Frog Reproduction (Ex. 13-20, p. 327)
5. Investigating a Model Gene Pool (Ex. 17-6, p. 440)
6. Investigating a Genotype Within a Fruit Fly Population (Ex. 17-10, p. 447)

PROJECTS

1. Prepare posters or bulletin board displays comparing mitosis and meiosis.
2. Collect plant samples such as algae, mosses and ferns and develop displays showing the life cycles of these organisms.
3. Raise small laboratory mice and investigate the role of hormones on reproductive behavior.
4. Maintain stock cultures of planaria for experiments in regeneration.
5. Maintain stock cultures of Drosophila strains for genetics experiments.
6. Make posters or bulletin board displays showing simple monohybrid and dihybrid crosses or the basic Mendelian principles.
7. Make a study of the occurrance of genetic traits in their own families.

REPORTS

1. Compare the life cycles of a select group of organisms.
2. The evolution of alternation of generations.
3. Biographical reports on such scientists as Wilhelm Roux, Hans Driesch, Hans Spemann, with particular emphases given to their contributions to embryology.
4. Unusual developmental processes, such as regeneration and cancer.
5. A biographical report on Gregor Mendel.
6. Non-Mendelian inheritance, such as:
   a. Color blindness
   b. Hemophilia
   c. Down's syndrome
   d. Turner's syndrome
   e. Klinefelter's syndrome
7. Investigate the principles of population genetics.
8. The effects of temperature, chemicals or radiation on the genetic material

RELATED PROBLEMS

1. Study population genetics and the Hardy-Weinberg Principle.
2. Use the chi-square method to determine reliability of experimental data.

DADE COUNTY 16mm FILMS

1. Patterns of Reproduction
   AV# 1-30449, 28', C
2. Asexual Reproduction
   AV# 1-02214, 10', BW
3. Basic Nature of Sexual Reproduction
   AV# 1-11122, 15', C
4. Reproduction
   AV# 1-30532, 28', C
5. Cell Reproduction
   AV# 1-30511, 30', C
6. Cell Division
   AV# 1-02236, 11', BW
7. Cell Biology: Mitosis and DNA
   AV# 1-13773
8. Mitosis and Meiosis
   AV# 1-11083, 15', C
9. Reproduction in Plants
   AV# 1-11051, 14', C
10. Plant Reproduction
    AV# 1-30649, 28', C
11. Flowers at Work
    AV# 1-02349, 11', BW
12. Reproduction in Animals
    AV# 1-02423, 11', BW
13. The Sex Cells
    AV# 1-30464, 28', C
14. Fertilization
    AV# 1-30454, 28', C
15. Reproductive Hormones
    AV# 1-30454, 28', C
16. Human Body: Reproductive System
    AV# 1-11249, 16', C
17. Reproduction Among Mammals
    AV# 1-02428, 11', BW
18. Plant Growth and Development
    AV# 1-30639, 28', BW
19. Plant Growth
    AV# 1-02273, 10', BW
20. Seeds and Germination
    AV# 1-31540, 28', C
21. Seed Germination
    AV# 1-11104, 14', C
22. Growth of Seeds
    AV# 1-11103, 14', C

23. Life of a Plant
AV# 1-02269, 10', C
24. Theories of Development
AV# 1-30459, 28', C
25. Animal Life Cycle
AV# 1-30539, 28', C
26. Cytoplasm and Differentiation
AV# 1-30779, 28', C
27. Development of Organs
AV# 1-30484, 28', C
28. Egg Into Life
AV# 1-13719
29. Development of the Chick
AV# 1-03856, 10', BW
30. Development of the Chick Embryo
AV# 1-03872, 5', C
31. Chick Embryo: From Primitive Streak to Hatching
AV# 1-11518, 13', C
32. Eggs to Chickens
AV# 1-03873, 10', C
33. Regeneration
AV# 1-30607, 28', C
34. Genetics: Improving Plants and Animals
AV# 1-11050, 14', BW
35. Animal Breeding
AV# 1-11511, 13', BW
36. Heredity and Environment
AV# 1-02226, 10', BW
37. Genetics: Mendel's Laws
AV# 1-13778
38. Mendel's Recombination
AV# 1-30592, 28', C
39. Mendel's Segregation
AV# 1-30582, 28', C
40. Heredity
AV# 1-02224, 11', BW
41. Blood Groups, Skin Color, and Gene Pools
AV# 1-30587, 28', C
42. Genes and Chromosomes
AV# 1-30429, 28', C
43. Chromosomes and Sex
AV# 1-30577, 28', C
44. Treasury of Human Genes
AV# 1-30418, 28', C
45. Genetics: Human Heredity
AV# 1-30806
46. Heredity and Pre-Natal Development
AV# 1-13029, 21', BW
47. Thread of Life (Part 1)
AV# 1-30568, 30', C
48. Thread of Life (Part 2)
AV# 1-30570, 30', C
49. Hereditary Basis of Evolution
AV# 1-30602, 28', C

DADE COUNTY FILM LOOPS

1. Cell Division (Biology No. 20051)
   AV# 7-10002, 2'30", C

DADE COUNTY TRANSPARENCIES

1. Mitotic Cell Division
   AV# 2-00008
2. Angiosperm: Flower
   AV# 2-00082
3. Structure of the Flower
   AV# 2-00001
4. Reproduction - Man
   AV# 2-00067
5. Life Cycle: Frog
   AV# 2-00202
6. Human Growth
   AV# 2-30076
7. Genetics: Resemblances and Differences Due to Heredity
   AV# 2-00073

SUGGESTED DISCUSSION QUESTIONS

1. In terms of evolution, which reproductive pattern (asexual or sexual) is biologically advantageous? Why?

2. How does the process of mitosis ensure genetic continuity?

3. Why is the process of meiosis essential to sexual reproduction? What does meiosis do in terms of the gene makeup of gametes?

4. Why are flowering plants so successful?

5. In the evolution of animals from a water to land existence, what reproductive problems developed? How were these problems overcome?

6. What determines the eventual fate of undifferentiated embryonic cells?

7. Why was Gregor Mendel's work ignored for so many years?

8. How do environment and heredity affect an individual organism?

9. How was the relationship between genes and chromosomes established?

10. How do spontaneous changes occur in the genetic material?

ADDITONAL INNOVATIVE ACTIVITIES

1. Use microslide viewers and booklets dealing with mitosis, reproductive patterns, the structure of a flower and animal embryology. (Materials available from National Teaching Aids, Inc., 120 Fulton Ave., Garden City Park, New York 11040)

2. Use LIFE educational reprint number 27, "Life Before Birth" as a summary after studying reproduction and development.

3. Use "genetic" corn to illustrate Mendelian ratios. (Available from Wards, Carolina Biological and from Turtox)

4. Describe careers that employ a knowledge of genetics; for example, animal breeding, agriculture or pest control.

REFERENCES

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6. Biological Sciences Curriculum Study Committee. Student Laboratory Guide-Biological Science: An Inquiry Into Life, 2nd. ed., New York: Harcourt, Brace & World, Inc., 1968.
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7 and 8	4, 30	1 Ch. 14, 17 2 Ch. 13 3 Ch. 16 4 Ch. 26 5 Ch. 18, 19	15, 16, 25	9, 10 11				2, 3	4	Act. #1
9 and 10	5, 21	1 Ch. 26 2 Ch. 13 3 Ch. 16 4 Ch. 47 5 Ch. 17	18, 26	12, 13, 14, 16, 17				4, 5	5	Report #1
11	9, 23, 32	1 Ch. 26 2 Ch. 13 3 Ch. 16 4 Ch. 47 5 Ch. 18	18, 26	29, 30, 31					5	
12	6	1 Ch. 26 2 Ch. 13 3 Ch. 16 4 Ch. 47 5 Ch. 18	18, 26	15		4				Project #3
13		1 Ch. 27, 28 2 Ch. 14 5 Ch. 18	3, 14, 29, 30, 31, 32	24, 26, 27					6	
14	7, 8, 22	1 Ch. 17 2 Ch. 14 4 Ch. 26 5 Ch. 19	15, 16, 25	18, 19, 20, 21, 22, 23,						
15	5, 9, 23, 32	1 Ch. 28 2 Ch. 14 5 Ch. 18	3, 14, 29, 30, 31, 32	24					6	Report #3
16	5, 9, 23, 32	1 Ch. 27 2 Ch. 14 5 Ch. 18	3, 14, 29, 30, 31, 32	25, 26, 27, 28, 29, 30, 31, 32				6	6	Act. #1

MASTER SHEET - CONTINUITY OF LIFE (con't)

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17	10, 24	1 Ch. 27 2 Ch. 14 5 Ch. 18	3, 14, 29, 30, 31, 32	33						Project #4 Report #4
18 and 19	12, 13, 15, 25, 26, 27, 28, 34, 35, 36, 37, 39, 40, 42, 44	1 Ch. 29 2 Ch. 15 3 Ch. 17 4 Ch. 9 5 Ch. 20	1, 2, 11, 13, 17, 19, 21, 22, 27, 28, 32	34, 35, 36, 37, 38, 39 40		1		7	7, 8	Projects #5 6,7 Report #5
20 and 21	11, 33, 40	1 Ch. 29 2 Ch. 15 3 Ch. 17 4 Ch. 9 5 Ch. 20	1, 2, 11, 13, 17, 19, 21, 22, 27, 28, 32	37, 38, 39, 40				7		Act. #3
22 and 23	14, 16, 17, 18, 36, 41, 42, 43	1 Ch. 30 2 Ch. 16 3 Ch. 17 4 Ch. 10, 11 5 Ch. 20	1, 2, 11, 13, 17, 19, 21, 22, 27, 28, 32	41, 42, 43, 44, 45		1,2,3, 5,6			9, 10	

ED 062179

AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

PERPETUATING THE SPECIES

5311.40
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SCIENCE
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DADE COUNTY PUBLIC SCHOOLS
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Written by C. Floyd and M. Miller
for the
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Miami, Fla.
1971

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PERPETUATING THE SPECIES

COURSE DESCRIPTION:

Content includes brief consideration of the concept of species: structure of organisms from atoms through cells to multicellular condition, types of reproduction in plants and animals and more extended treatment of the laws of heredity, genetic principles, and structure and function of DNA, genes and chromosomes.

The course includes discussion, reading, problem solving (mathematics applied to genetics problems), short-term laboratory experiments, and special research projects.

ENROLLMENT GUIDELINES:

The student who is not college bound should have this course as a general preparation for life course. It can be useful to one entering the paramedical fields.

STATE ADOPTED TEXTS

1. Brandwein, P. F.; Burnett, R. W.; and Stollberg, R. Life: Its Forms and Changes. New York: Harcourt Brace and World, 1968.

2. Frazier, R. P. and Smith, H. A. The Biological Sciences, Investigating Man's Environment. River Forest, Illinois: Laidlaw Bros., 1969.

PERFORMANCE OBJECTIVES

The student will:

1. Relate three major factors on which the concept of species depends.

2. Draw a typical DNA molecule going through the stages of replication.

3. Differentiate the structures and functions of DNA, the gene and the chromosome.

4. Contrast sexual reproduction and asexual reproduction as to its effect on perpetuating the species.

5. Contrast internal and external fertilization.

6. Contrast internal and external development.

7. Compare mitosis and meiosis using a diagram.

8. Trace development of the individual from zygote to embryo.

9. Apply rules of probability in predicting outcome or events in genetics.

10. Relate causal factors to genetic change.

11. Solve monohybrid and dihybrid-cross problems using the punnett square or algebraic method.

12. Given the necessary data construct a test cross.

13. Apply the laws of genetics as to how organisms are changed by natural and artificial means.

14. Summarize the difficulties of human heredity investigations.

15. Contrast theories of evolution which have significance in our better understanding the concept of inherited characteristics.

16. Describe the work done by modern day scientists relative to theories dealing with the origin of life.

COURSE OUTLINE

I. Concept of Species

A. What constitutes a species
1. Organisms with ability to interbreed
2. Groups of individuals having the same chemical code within cells (inheritance factor)
3. Individuals which produce offspring like themselves

B. What constitutes the inheritance factor
1. DNA
2. The gene
3. Chromosomes

II. Reproduction ... The Means for Perpetuating the Species

A. How living things maintain their kind
1. Chromosomal continuity
2. Production of somatic cells (mitosis)
3. Production of gametes (meiosis)
4. Fertilization

B. Asexual reproduction in lower plants and animals
1. Binary fission
2. Budding
3. Spore formation
4. Regeneration
5. Vegetative propagation
a. Natural
b. Artificial

C. Sexual reproduction in higher plants
1. Flower structure
2. Pollination
3. Fertilization
4. Seed Structure
5. Seed dispersal
6. Germination of seed

D. Reproduction in higher animals
1. Reproductive organs in mammals
2. Reproductive cell formation - meiosis
3. Embryonic development - mitosis
a. Blastula stage
b. Gastrula stage

III. Genetics and heredity

A. The science of genetics
1. Heredity defined
2. Genetics defined

B. Mendelian laws of heredity
   1. Dominance
   2. Unit of character

C. Chance and probability

D. How heredity traits are transmitted to offsprings
   1. The gene and DNA
   2. Diagraming Mendelian ratios
      a. Mating a pure dominant with a pure recessive
      b. Mating two hybrids
   3. Dihybrids
   4. Linkage of genes
   5. Causes of mutations
   6. Chromosome changes

E. How the laws of heredity improve living things
   1. Plant improvement
      a. Selection - artificial
      b. Selection - natural
      c. Distribution of variations
      d. Limitation of improvement by selection
      e. Hybridization
      f. Inbreeding and outbreeding
      g. Genes and population
   2. Methods of animal improvement
      a. Difficulties of breeding improved animals
      b. Selection and hybridization
      c. Inbreeding of animals
      d. Animal mutants
   3. Natural environment role in change
   4. Heredity and man
      a. Difficulties of investigation
      b. Dominant human traits
         1. Brown eyes
         2. Curly hair
         3. Dark hair
         4. Extra fingers
         5. Normal sight
         6. Normal mentality
      c. Recessive human traits
      d. Heredity defects
         1. Certain congenital defects
         2. Color blindness
         3. Deaf-mutism
         4. Defective fingers
         5. Defective toes
         6. Certain types of feeble mindedness
      e. Improvement of mankind
         1. Eugenics - by heredity
         2. Euthenics - by improving environment
      f. Multiple alleles

IV. Living things ... Theories of Evolution

EXPERIMENTS

Biological Science Curriculum Study. An Inquiry Into Life. New York: Harcourt Brace and World, Inc., 1968.

1. A Population Genetics Study (Inquiry 32-1, p. 200)
2. Alternation of Generations (Inquiry 14-1, p. 90)
3. Charts for Testing Color Blindness (p. 238)
4. Flowers (Inquiry 17-1, p. 110)
5. From Seed to Seedling (Inquiry 17-3, p. 117)
6. Heredity and Environments (Inquiry 30-2, p. 198)
7. Inheritance of One-factor Differences (Inquiry 29-3, p. 188)
8. Investigating Differences in Peas (Inquiry 8-3, p. 59)
9. Levels of Biological Organization (Inquiry 8-4, p. 62)
10. Life from Non-Life (Inquiry 2-1, p. 22)
11. Randomness, Chance and Probability (Inquiry 20-2, p. 184)
12. Sex Linked Inheritance (Inquiry 30-1, p. 197)

Biological Science Curriculum Study. Biological Science: Molecules to Man. Boston: Houghton Mifflin Co., 1968.

13. Investigating Cell Division (p. 270)
14. Investigating Development of the Plant Embryo (p. 342)
15. Investigating the Effects of Mutants in Bacteria (p. 244)
16. Investigating the Influence of Heredity and Environment on Plant Pigmentation (p. 377)
17. Investigating Natural Selection (p. 77)
18. Investigating Reproduction in Flowering Plants (p. 306)
19. Investigating Some Properties of Life (p. 102)
20. Investigating Variation within a Species (p. 70)

Biological Science Curriculum Study. Patterns and Processes. New York: Holt, Rinehart and Winston, Inc., 1966.

21. Laboratory Activity S-95 Hybrid Tobacco Seed (p. 207)
22. Laboratory Activity S-106 Pipe Cleaners (p. 224)
23. Produce a Plant 13Y Sexual Reproduction (p. 149)
24. Laboratory Activity S-99 Second Law of Probability (pennies) (p. 215)

Brandwein, P. F., Brunett, R. W., and Stollberg. Life Its Forms and Changes. New York: Harcourt, Brace and World, 1968.

25. An Apprentice Investigation into the Size of Genes (p. 443)
26. Dry Lab, Using Colored Cardboard Cut-Outs to Construct DNA Model (p. 465)
27. Reproduction in Flowering Plants (p. 293)

Frazier, R. P., and Smith H. S., The Biological Sciences, Investigating Man's Environment, River Forest, Illinois: Doubleday, 1969.

28. Find Out by Trying-Comparing Bean Types-Species Characteristics (p. 67)

29. Find Out by Trying-Responses in Amoeba (p. 26)
30. Do It Yourself-Replant Species of Plants in Different Habitats (p. 436)
31. Do It Yourself-Observe Chromosomes (p. 396)
32. Investigations to Carry Out #2, Flowers-A Comparative Study of Self-Pollination/Cross Pollination (p. 405)
33. Do It Yourself-Compare Slides of Embryos of Pig, Chick, Frog (p. 348)
34. Find out by Trying-F_2 Generation-Single Characteristic Cross (p. 374)
35. Find out by Trying-Fruit Flies Monohybrid Cross (p. 383) White eyes-Red eyes also Sex and Recessive Traits

Lawson, Chester A. and Paulson, Richard F. Laboratory and Field Studies in Biology. Source Book For Teachers of Biology. New York: Holt, Rinehart and Winston, 1960.

36. A Demonstration of Meiosis Study (p. 346)
37. Are All Members of a Species Alike? (Study 4, p. 44)
38. Artificial and Natural Selection for and against Albinoism. (Study 3, p. 381)
39. Bean-Picking and Genetics (Study 6, p. 335)
40. Growth in Plants and Animals (Study 13, p. 151)
41. Maintaining Living Organisms in the School Laboratory (p. 493)
42. Overpopulation and Limiting Environments (Study 1, p. 475)
43. Sex Chromosomes and Sex Linkage (Study 14, p. 359)

DEMONSTRATIONS

Biological Science Curriculum Study. Patterns and Processes. Teachers Handbook, 1963.

1. Chick Embryo Development (Lab. activity - S-83, p. 164)

Lawson, Chester A. and Paulson, Richard F., Laboratory and Field Studies in Biology. New York: Holt, Rinehart and Winston, 1960.

2. Study 8. A Demonstration of Meiosis (p. 346)
3. Study 1. Heredity and Environment (p. 322)
4. Study 2. Population Pressures and Succession in a Laboratory Community (p. 21)

Biological Science Curriculum Study (BSCS Yellow). An Inquiry Into Life. New York: Harcourt Brace and World Inc., 1968.

5. How Does An Egg Form a Chicken? (Inquiry 27-2, p. 173)
6. Reproduction and Development in the Frog. (Inquiry 27-1, p. 169)

Brandwein, P. F., Burnett, R. W., and Stollberg. Life Its Forms and Changes. New York: Harcourt Brace and World Inc., 1968.

7. An Apprentice Investigation of Genetic Ratios Using Blue and Yellow Beads (p. 431)
8. An Apprentice Investigation Into Messenger RNA Using Sugar Crystallization Model (p. 469)

PROJECTS

1. An apprentice investigation of hereditary traits - tongue rolling - earlobes. P.O. 10*. Brandwein, Brunett, Stollberg. Life Its Forms and Changes (p. 443)
2. Collect Sea Urchin eggs and conduct fertilization experiment. P.O. 5 and 6.
3. Design a chart illustrating the ideas about mutation held by DeVries, Muller, Beadle and Tatum. P.O. 10 and 14.
4. Diagram-Pollination-Fertilization in Angiosperms in a Chart. P.O. 5.
5. Diagram the processes of mitosis and meiosis in a chart. P.O. 6 and 7.
6. Explore combinations possible with four letter TAEM (p. 391, Ref. 14) as lead in to understanding ncleotide, sequence possibilities. P.O. 3.
7. Grow radish seedlings and design an experiment that will test several types of pollutants on seedling growth. P.O. 13.
8. Interview a medical doctor who is a specialist in birth defects. P.O. 13 and 14.
9. Make a chart illustrating the acetabularia experiment. P.O. 3.
10. Make a fingerprint record of members of your immediate family. Try to determine if fingerprints are inherited. P.O. 14.
11. Prepare a chronological chart showing man's achievements in heredity - genetics studies. P.O. 15 and 16.
12. Study flowers of three different plants and attempt to determine which are self pollinated or cross pollinated. P.O. 5 and 6.

REPORTS

1. Causes of mutations. P.O. 10 and 13.
2. Chromosome Mapping
3. Darwins Theory of Evolution: Then and Now. P.O. 15.
4. DeVries and Primroses. P.O. 13 and 15.
5. Dr. Severo Ochoa and his work with DNA. P.O. 15.
6. Effects of Intermarriage on Royal Blood Lines. P.O. 15.
7. Gregor Mendel. P.O. 10, 13, and 16.
8. Hemophilia P.O. 3.
9. Mitosis - Meiosis. P.O. 7.
10. Modern Day Investigations in Heredity. P.O. 16.
11. Nature vs. Nurture ... An Organism is the Product of Heredity and Environment. P.O. 13.
12. Protein Synthesis. P.O. 2 and 16.
13. Researchers in Biochemical Genetics. Example, E. L. Tatum, George Beadle and Linus Pauling. P.O. 16.
14. Sex - Linked Characteristics. P.O. 15.
15. Watson and Crick. P.O. 16.
16. Where the Elements in DNA Originate. P.O. 3.
17. X-Ray Induced Mutations in Neurospora. P.O. 10.

*Note: P.O. - Performance Objective

FIELD TRIPS

1. Commercial Nursery. P.O. 4, 5, 6, and 10.
2. Fairchild Tropical Garden. P.O. 4, 5, 6, and 10.
3. Redlands Fruit and Spice Park. P.O. 4, 5, 6, and 10.
4. South Florida Amateur Orchid Society. P.O. 4, 5, 6, and 10.
5. Poultry Farm. P.O. 4, 5, 6, and 10.
6. United States Plant Introduction Center. P.O. 4, 5, 6, and 10.

SPEAKERS

1. Dade County Medical Association
2. Dade County Redland Fruit and Spice Park
3. Goldweber, Seymour, Dade County Agricultural Agent

ADDITIONAL INNOVATIVE ACTIVITIES

1. Prepare a script of an interview between an inquiring reporter and Dr. James Watson to be tape recorded. P.O. 16.
2. Have students compete in designing a crossword puzzle on heredity and genetics. P.O. all.
3. Offer students the opportunity to design a teaching game which would help other students learn the DNA - Replication concept. P.O. 2 and 3.

DADE COUNTY 16mm FILMS

1. Adaptations of Plants and Animals
   AV# 1-11059, 13' C
2. Animal Breeding
   AV# 1-11511, 13' BW
3. Animal Life Cycle, An
   AV# 1-30539, 28' C
4. Animal Predators and The Balance of Nature
   AV# 1-05650, 11' C
5. Asexual Reproduction
   AV# 1-02214, 10' BW
6. Birth of a Florida Key
   AV# 1-12252, 18' C
7. Camouflage in Nature Through Form and Color Matching
   AV# 1-02655, 11' C
8. Cell Biology: Growth and Replacement
   AV# 1-30510, 30' C
9. Cell Biology the Unit of Life
   AV# 1-30525, 30' C
10. Cell Division
    AV# 1-02236, 11' BW
11. Cell Reproduction (mitosis)
    AV# 1-30511, 30' C
12. Chick Embryo, The: From Primitive Streak to Hatching
    AV# 1-11518, 13' C
13. Chick Embryo, The: From Streak to Hatching
    AV# 1-30510, 13' C
14. Color of Life, The
    AV# 1-30664, 24' C
15. Chromosomes and Sex
    AV# 1-30579, 28' C
16. Darwin and Evolution
    AV# 1-02241, 28' C
17. Darwin and Evolution
    AV# 1-30553, 28' C BW
18. Development of the Chick Embryo
    AV# 1-03872, 5' C
19. DNA: Molecule of Heredity
    AV# 1-11078, 16' C
20. Eggs to Chickens
    AV# 1-03873, 10' C
21. Evolution of Man
    AV# 1-30389, 28' C
22. Fertilization
    AV# 1-30464, 28' C BW
23. Flowers at Work
    AV# 1-02347, 11' BW
24. From Atoms to Organisms
    AV# 1-30399, 28' C
25. Genes and Chromosomes
    AV# 1-30429, 28' C

26. Hereditary Basis of Evolution
AV# 1-30602, 28' C

27. Heredity and Environment
AV# 1-02226, 10' C

28. Mendel's Recombination
AV# 1-30592, 28' C

29. Mendel's Segregation
AV# 1-30582, 28' C

30. Mitosis and Meiosis
AV# 1-11083, 15' C

31. Mutation
AV# 1-30597, 28' C

32. Natural Selection and Adaptation
AV# 1-30565, 28' C

33. Origin of Life
AV# 1-30613, 28' C

34. Patterns of Reproduction
AV# 1-30440, 28' C

35. Plant Reproduction
AV# 1-30649, 28' C

36. Radiation and Biology: An Introduction
AV# 1-11101, 14' BW

37. Seeds and Germination
AV# 1-131540, 28' C

38. Species: Stability and Change
AV# 1-30543, 28' C

39. Thread of Life, The (part 1)
AV# 1-30568, 30' C

40. Thread of Life, The (part 2)
AV# 1-30570, 30' C

41. World of Dr. Vishniac, The
AV# 1-11070, 20' C

FILM LOOPS

1. Animal Camouflage
2. Blood Smear Preparation
3. Mitosis
4. Regulation of Plant Development
5. Smear and Smash Techniques

FILM STRIPS

1. Darwin Discovers Nature's Plan
2. Development of Embryos
3. Evolution Abiogenesis vs. Biogenesis
4. Evolution: Theories Past and Present
5. Evolution: Theories Past and Present
6. Evolution Today
7. Living Things and Radiation
8. Man Inherits the Earth
9. Man's Search for his Ancestors
10. Face: The Study of Human Variation

REFERENCES

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3. Asimov, Isaac, The Genetic Code.* New York: Signet Science, 1963.
4. Biological Science Curriculum Study. Student Laboratory Guide, An Inquiry Into Life. New York: Harcourt Brace and World, Inc. 1968.
5. Biological Science Curriculum Study. Patterns and Processes. New York: Holt, Rinehart and Winston, Inc., 1966.
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11. Darwin, Charles. The Origin of Species.* New York: New American Library, 1958.
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13. Fisher, Ronald A. The Genetical Theory of Natural Selection.* New York: Dover, 1958.
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17. Kelb, Haven C. and others. High School Biology. (BSCS - Green Version) Chicago: Rand McNally and Co.
18. Lawson, and Paulson. Laboratory and Field Studies in Biology. New York: Holt, Rinehart and Winston, 1960.
19. Medawar, P. B. The Future of Man.* New York: Mentor, 1961.
20. Michelmore, Susan. Sexual Reproduction.* Garden City, New York: The Natural History Press, 1946.
21. Montague, Ashley. Human Heredity.* New York: Mentor, 1960.
22. Moore, John A., and others. Biological Science: An Inquiry Into Life. (BSCS-Yellow Version) New York: Harcourt Brace and World, Inc., 1968.

* Paperback books

23. Mottram, V. H. The Physical Basis of Personality.* Baltimore: Penguin, 1952.
24. Oxenhorn, Joseph M. The Next Generation, Pathways in Science Biology. New York: Globe Book Company, Inc., 1970.
25. Peters, James A., ed. Classic Papers in Genetics.* Englewood Cliffs, New Jersey: Prentice Hall Inc., 1959.
26. Scheinfeld, Amram. The Basic Facts of Human Heredity.* New York: Affiliated Publishers Inc., 1961.
27. Sheppard, P. M. Natural Selection and Heredity.* New York: Harper and Row, 1960.
28. Thunber, Walter, and Kilbun, Robert. Exploring Life Science. Boston: Allyn and Bacon, Inc., 1966.
29. Wallace, Bruce and Adrian N. Adaptation.* Englewood Cliffs, New Jersey: Prentice Hall, 1961.
30. Welch, Claude, and others. Biological Science-Molecules to Man. (BSCS Blue Version). Boston: Houghton Mifflin, 1968.
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MASTER SHEET - PERPETUATING THE SPECIES

Objectives	Experiments	Student Text	Supplementary Resources	Films 16mm	Film Loops	Reports	Film Strips	Speakers	Projects	Demonstrations
1	37, 23, 10, 19	7 p. 225 14 pp. 27, 30, 57, 60-61, 365-400, 436-438	5, 9, 17, 22, 24, 30	1, 7, 32, 33	1		1			2
2	4	7 pp. 466-468 470,484-485 14 pp. 37, 48-51, 64-65, 374-385,389 393-399		9, 39, 40		12				8
3	31, 25, 26	7 pp. 457-458 463-464,470-472, 478 14 pp. 37, 48, 51, 64, 65, 370,374-375 389-400		19, 24, 25, 33, 39, 40 14, 15	5	8, 16			6, 9	
4	4, 18, 23, 37, 40, 42	7 pp. 80, 220, 230-234,237, 251,264,266, 268,298-300 14 pp. 27,99-100 183-191,374-385,342-356	5, 9, 17, 22, 24, 30	8, 22, 23, 24	4					
5	6, 27, 32, 41	7 pp. 294,295, 435,436 14 pp. 150-151 183-191,253-254,342-356	5, 19, 17, 22, 24, 30	2, 3, 12, 13, 18, 22, 34, 37					2,4,12	
6	10, 13, 27, 32 41	7 pp. 294,295 388,389,453-455,183-191, 208,209,214		18, 22, 34, 37, 2, 13, 12,	4		2		2,5,12	6
7	15, 37	7 pp. 230-231, 293,434-436, 438,467 14 pp. 47-51, 375-378		10, 11, 30	3	9			5	2
8	15, 33	7 pp. 294-295, 388,389,453-455 14 pp. 150-151, 217,218,221, 225,234,345-347,374	5, 9, 17, 22, 24, 30	18, 20, 40, 3, 12, 13, 15			2			1,5,8
9	34, 21, 22, 24, 39, 1, 3, 35	7 pp. 426-432 14 pp. 367-374, 103		16, 17	2					7
10	41, 42, 30	7 pp. 450-452, 479-482,485, 489 14 pp. 383-385, 394,395,399-400,434-435		31, 38		1,7,17	1,7,10	2, 3	1, 3	

MASTER SHEET - PERPETUATING THE SPECIES (con't)

Objectives	Experiments	Student Text	Supplementary Resources	Films 16mm	Film Loops	Reports	Film Strips	Speakers	Projects	Demonstrations
11	35, 9, 34	7 pp. 427-430, 432,435,436, 448,452 14 pp. 367-373		35						
12	9	7 pp. 427-430, 432,435,436, 449,452 14 pp. 367-373					2			
13	30, 38, 7, 17	7 pp. 450-452, 479-482,485, 489 14 pp. 383-385, 394-399,400, 434-435		28, 29, 31 32, 36, 4, 7, 16, 17	1	1,4,7, 11	1,7,8, 10	2,3	7, 8	
14	43, 3, 4	7 pp. 436-441 14 pp. 364,379-382,399-400		27			8, 10	1	3,8,10	
15	1, 13	7 pp. 488-490 14 pp. 428-445	5, 9, 17, 22, 24, 30	27, 41, 16, 17, 21, 26		3,4,5, 14	1,4,5, 6		11	4
16	20	7 pp. 445-446, 466,478-482 14 pp. 408-425	5, 9, 17, 22, 24, 30	33, 6, 41		7,10, 12,13, 15	9,3,4, 5,6		11	